# SYNTAX

SERVING TIMEX-SINCLAIR PERSONAL COMPUTERS

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## SINCLAIR ANNOUNCES QL; PLANS US MKT RE-ENTRY

Sinclair Research, Ltd announced in London a new machine--the Sinclair QL--using the 68008 processor running at 7.5 MHz. Late February should see initial shipments in the UK, with production building to 20,000/mo by summer. Introductory price in the UK is $599, but the US price will likely be $499 when the machine arrives here, perhaps by fall of 84. Specs call for a word-processing quality, 65-key keyboard with 5 keys for functions & 4 cursor control keys. With a monitor, you'll get 85 char. by 25 lines, but only 40-60 characters with TV display. Display outputs to both BW RGB monitors and PAL UHF TV characterize the UK version. Standard memory of 128K with two improved microdrives (100K each) plus bundled software from Psion for word-processing, data base, spreadsheet & graphics make a powerful machine. Although the QDOS operating system & Sinclair SuperBASIC set the machine apart, the multiple-window feature and export/import of files between programs place this design well ahead of similarly priced machines. Up to 6 more microdrives & a Sinclair Local Area Network can attach to this processor. Other features include 32K ROM with provision for 64K ROM cartridges & 4-color high-resolution (512x256) screen or 8-colors at 256x256 dots, 2 RS-232C serial ports and a realtime clock.

Sinclair SuperBASIC is fully procedure-structured and extendable. Execution speed does not depend on program size.

Thorn-EMI produces the QL. Sinclair plans to distribute in the US by mail-order.

SYNTAX expects this machine to be in short supply since it competes functionally with machines currently selling at 2-3 times its projected price. Sinclair interfaces for parallel printers, Winchester disks, & IEEE-488, as well as 500K memories, will follow.

In other news, Micro-Prolog (a training AI language) is available for the Spectrum.

See page 4 for more ZX/TS news from CES.

**SYNTAX ERRORS:** Change First-loader's translation table to 32 at 44125 and 14 at 44126. Some Upload tapes from E-Z Key share the error. This doesn't affect translations, & both programs run correctly. Use a Winky Board II to load ZX/TS tapes.

Connector diagrams in this issue supercede information published in SYNTAX Dec.83 p1.

## PROGRAM IMPROVEMENTS

To see more ROM calls in Marty Iron's program translated for the 2068, you must change lines 100 and 210 to use 14446 instead of 7679. Expect run time of about 1 hour.

Cassette Labeler needs changes in lines 270 and 370 if you want to use full 30-character lines on a 2068 version. Insert PRINT AT 18,0 in both locations.

John Slattery, Chatham Township, NJ

## VENDOR REPORT

SYNTAX expects to get its act together by March 84.

Larry Weigel of Synergistic Designs can be reached by telephone through 312/252-6356. Larry says the company expects to move to a new location in the Chicago area by the end of the first quarter.

E. Arthur Brown does not have thermal labels in stock, nor does any other vendor known to SYNTAX.

ECC publications professed no knowledge of any problem with issue 7 of Timex-Sinclair User on 5 Jan 1984. SYNTAX has not received its subscription copy, and we have no report from the UK parent company. If you wish to complain, your bank or credit card company and your postmaster should assist you. Or you may write to Mr. Richard Hease, Chairman, ECC Publications, 196-200 Balls Pond, London, UK N1 4AQ.

Although the New York Attorney General sends form letters claiming inability to locate any assets, you should file complaints about FROG. SYNTAX believes the FROG case could be serious--it's crucial to build a substantial file in Albany. Call 518/474-5481 for complaint forms.

ZXLR8 orders will be filled by G. Russell--Electronics. Send new orders to RD 1 Bx 539, Centre Hall, PA 16828 ($11 ppd). Advanced Interface Designs no longer sells this high-speed load-save program.

We have two more complaints about non-delivery from KOPAK. The complainants have neither product nor refund. KOPAK informs us they will ship EZ-LOADER starting Feb.8.

## ZX/TS USERS' GROUPS

To check for a local group that's not listed, or to announce a new group, call 617/456-3661 or write SYNTAX, RD 2 Box 457, Bolton Rd., Harvard, MA 01451. Send SASE for name of group in your area.

**Dayton, OH:** T/S Research Computer Club, Steve Douglas, 1515 Canfield Ave., Dayton, 45406, 513/278-8163.

**Long Island, NY:** L.I. Sinclair Timex Group, Paul Donnelly, 10 Idle Day Dr., Centerport, NY 11721. Send phone number or SASE.

**Roanoke, VA:** Roanoke-Franklin County Timex-Sinclair Area User's Group meets the first Monday of every month, Salvation Army Hqtrs, 7th St. and Dale Ave., 7-9 pm. Contact Gary Preston, 703/576-2390, or Capt. Jim Worthy, 703/343-5335.

**Franklin County, VA:** Sinclair Local User Group has changed its name to the Southern Virginia Timex User's Network. Their newsletter, SLUG, now goes by the name of TUG-LINES. Contact Gary Preston, Rt 1 Box 21, Glade Hill, VA 24092.

**Mexico:** ZX/TS Users Group of Mexico. Contact Miki Kronish, Apdo. Postal 5-450, Guadalajara, Jalisco, MEXICO.

## NEW PRODUCTS AND SERVICES

Prentice-Hall publishes two new books for the ZX/TS: TIMEX/Sinclair Interfacing: Tested Interfacing Projects for the ZX80, ZX81, and Timex/Sinclair 1000 (includes instructions for building a relay controller, A-D and D-A converter, joystick interface, printer interface, memory, etc., including pin-outs and specs for chips used) for $10.95 paperback/$17.95 clothbound, by James Downey and Don Rindsberg; 30 Games for the Timex/Sinclair Computer (simulation, fortune telling, graphics) for $4.95 paperback/$9.95 clothbound, by William Behrendt. Available from Prentice-Hall, Englewood Cliffs, NJ 07632, 201/592-2640.

G. Russell Electronics announces four new products: The SRS Speech Recognition System includes an amplifier and software on cassette for recognizing up to eight spoken words. For TS2068 and 16K ZX/TS at $34.95 assembled, $29.95 kit. COMPCOOLER allows you computer to run cooler by reducing the voltage at the 9VDC jack. $7.95 for ZX/TS (except TS1500). KEY cassette program provides UNLOCK to LIST and SAVE normally unlistable programs, PROTECT to shift programs above RAMTOP, MERGE to combine programs, and BYTES REMAINING to give RAM available. $10.00 for 16K ZX/TS. WINKY 2000 makes loading TS2068 tapes easier and lets you copy any program you can LOAD. Includes monitor jack and LED (avail. Mar. 84). G. Russell Electronics, RD 1 Box 539, Centre Hall, PA 16828.

DO-CALC consists of six linked routines: Calculator, Factorial, Accounting/Statistics, Running Balance, Tranform/Regression, and Compound Interest. Written in BASIC for 16K ZX/TS. $16 ppd. from B.V. Gerber, 3707 Downey Dale Dr., Randallstown, MD 21133.

Banta Software offers three new packages for the 2068. SCREEN-SOLV, an electronic worksheet for engineers and scientists, capable of solving algebraic or trigonometric equations and definite integrals, allows up to 48 user defined variables and six 96 element arrays, incorporation of final formulae into BASIC programs, and 288 step SCREEN-SOLV programs. Results can be tabulated or plotted. Available March 84 for around $35. SCREEN-CALC, a Visicalc-like spreadsheet program, allows up to 1008 cells containing an 8 letter label and a number. All standard TS BASIC functions may be entered into cells. Other features include sums, averages, conditionals, loops, and menu-driven operation, all for $19.95. FOOTBALL, a colorful, challenging strategy game, offers both offensive and defensive plays for one or two players. $14.00, from Banta Software, 8088 Highwood Way, Orangevale, CA 95662, 916/722-4895.

Robotec Inc. introduces RAMPAGER, a machine code monitor for 16K ZX/TS machines. Allows entry of bytes in hexidecimal, inserts bytes (bumping all other bytes up), displays and prints memory in decimal, hex, and characters. It is NOT an assembler or disassembler, but it is written entirely in machine code and loads in under 75 seconds. $9.95 + $1.25 P&H from Robotec Inc., 59 C St., Ampoint Ind. Park, Perrysburg, OH 43551, 419/666-2410.

Color Graphics deals with practical applications of high resolution graphics on the TS2068. Includes techniques for 3-D drawing, maps, geometric figures, pie, bar, and line charts, characters and shapes, and moving objects on the screen. Contains 45 tested program listings with notes. By Nick Hampshire, $12.95 paperback from Hayden Book Co., 10 Mulholland Dr., Hasbrouck Heights, NJ 07604, 201/393-6306.

**TIMEX SHOWS NEW PERIPHERALS**

| Model | Description | Avail | Price |
|---|---|---|---|
| TS2050 | Modem | Now | $120 |
| TS2060 | Interface | 2Q 84 | $110 |
| TS2080 | 80 Col. Printer | 1Q 84 | $325 |
| TS2065 | Microdrive | 2Q 84 | $65 |

Timex displayed these products at the 1984 Consumer Electronics Show in Las Vegas. Prices and availability are approximate.

Timex's new TS2050 Modem works with all Timex-Sinclair computers and includes menu driven software on cassette. It features direct modular connection, auto-dial, and auto-answer. An optional command cartridge for the 2068 dials up to 14 numbers and contains automatic logon procedures.

For expanding the capabilities of the 2068, the TS2060 Interface provides buffered bus expansion, RS232-C serial and Centronics parallel ports, a port for an extra 32K RAM. RGB color monitor output with audio, a networking facility for up to 64 TS2068s, and a port for up to 8 microdrives.

Plugging into the Centronics port of the interface, the TS2080 printer provides 80 columns of dot matrix output, including all the characters in the TS2068, in normal or italicized format. It looks like a full sized computer printer, and has a price to match.

The most exciting item shown, the TS2065 Microdrive, reads and writes tiny tape cartridges about the size of a thin book of matches. Each cartridge contains 20 feet of tape in a continuous loop and can store 80 to 100K bytes of data. During formatting, the drive looks for faulty portions of the tape and locks them out; thus the storage figure is expressed as a range. A perfect tape holds 100K. The tape runs at 30 ips, so the entire loop passes in 8 seconds. This translates to a transfer rate of 102,400 baud on a perfect tape. The Microdrive system supports both program and data files using standard TS2068 commands such as CAT, ERASE, FORMAT, OPEN, etc. The CAT(alog) command reads the entire tape; there is no single directory area on the tape. The Microdrives are powered from the computer. Timex imports them from Sinclair while gearing up their facilities.

Sinclair Research demonstrated their flat-screen black and white pocket television, with automatic television standard selection, focus, horizontal and vertical hold, brightness and contrast. It measures 5.5x3.5x1.25 inches, weighs 12 oz., and costs $100. Slated availability: Mid 1984.

Cedric Bastiaans, Los Angeles CA

**HARDWARE REVIEW**

Product: UM-64 Memory Module
Machines: ZX/TS (not TS2068)
From: Byte-Back Co.
Rt. 3 Box 147 Brodie Rd.
Leesville, SC 29070
803/532-5812
Price: $119.95 Assembled
$109.95 Kit
+$4.95 P&H

Using bigger memories creates opportunities for greater losses in a crash. Byte-Back's battery-back-up scheme cuts this risk. You'll also get the possibility to have your operating system in RAM (all but the characters), compatibility with the TS1500, switch-selectable banks in the 8-16K area, an EPROM socket you can switch-select into 8-16K, and reasonable documentation from a company that maintains an evening help line.

When power fails, 6 alkaline batteries (AA size) keep power on your system for up to 30 minutes. These backup batteries supply 9V to the entire system, including other peripherals. Don't run high-drain items--like a ZX printer--from the backup system. Also, if you're going to SAVE to tape, you'll need a battery-powered tape recorder.

You'll need fresh batteries to get protection with this circuit because the regulator will drop out at 1.22V per cell. Most cells are rated at end-point voltages of 1.1V or less--you can expect about 1/3 rated life in this circuit. The batteries only operate when power fails, so the calendar time can be quite long. SYNTAX recommends testing the backup feature regularly, with non-crucial data.

If you need longer backup times, you can change to a larger battery holder, mounted externally, or modify the circuit to use a re-chargeable pack similar to the ones described in SYNTAX (Aug.82 p.5).

Don't use the Reset function during battery operation. Doing so would wipe out all memory--not just 16-32K. When you lose power, this backup runs your whole system.

With your UM-64, you get MC & instructions to move your operating system into the RAM, where you can modify the code as you wish. Our simple test modified the graphic character codes to make both the 1 & 2 keys print the 1-key graphic--not sophisticated, but enough to see that we really operated from RAM. Changing the character set code in the RAM will not suffice to change the characters, though. The part of your ZX/TS that reads these codes is isolated electronically from the edge-connector where the UM-64 attaches. One use is to change printer USR calls to use LLIST, LPRINT and COPY.

Byte-Back's UM-64 will work on your TS1500, as well as on the other ZX/TS machines. Of course it doesn't work on Spectrums or 2068s.

SYNTAX could not get the UM-64, TS1500 and MW-100 printer to function together. By telephone, Jerry Minchey informed us that this is a timing problem for which Byte-Back provides a fix incorporated in later production models than we tested. This fix also allows you to LOAD 32K BASIC programs directly and Jerry will provide it at no charge to people who need it.

In a nice touch, this memory provides two sets of switches to control the 8-16K block. Four of these disable 2K blocks of internal RAM; four control the address of the built-in PROM socket. If your system uses one set configuration, you won't mind having to open the case to set the switches. SYNTAX constantly reconfigures systems and suggests that you may want to cut a slot in the case.

Documentation includes a parts list, schematic, component layout, and clear directions for use. You also get a clearly stated warranty, a real address, and a phone number.

Construction of this unit uses generally good practice. You will find one piggy-backed IC, a diode, a resistor, and a 3-inch wire that provide a ROM CS function. Also, the battery leads can extend out of the case for your convenience. None of these are, by themselves, bad--but all can cause you trouble in a place with lots of vibration. For most uses, expect no trouble. We like the gold, bifurcated contacts on the connector.

**HARDWARE REVIEW**

| | |
|---|---|
| Product: | ROMPAK ROM Card |
| Machines: | ZX/TS Machines (not 2068) |
| From: | Rompak, 8206 Blackburn Ave., Los Angeles, CA 90048, 213/653-9741 |
| Price: | $16.95 Assem., with ZIF<br>$9.95 Kit, without ZIF<br>+$2.00 P&H |

ROMPAK permits you to use many programs instantly--cartridges in the rough. An adaptor plugs onto your ZX/TS and provides a socket to contain the program ROM. A simple machine code routine in the ROM moves the program into RAM in under a second, and you're ready to go.

You can buy the assembled type with ZIF (Zero Insertion Force) socket, or the kit with regular socket (ZIF socket separately

$4.95). Both versions include an extender to connect other peripherals. Rompak recommends the ZIF socket and SYNTAX advises using the regular socket only for ROMs you will never change.

This product reads 2764 or 2732 EPROMs in the unused 8-16K block of ZX/TS memory. The newest version has a jumper for 2716s.

One page of instructions give all the necessary cautions. Every word on this sheet is important--read before destroying (your ROM, computer, adaptor, or all three).

Components and design of this product show good judgement. Our assembled version is well-built, and uses a bifurcated, gold-contact connector that fits very tightly. Tin-plated extender pins allow you to connect other peripherals. The double-sided glass circuit board is cleanly laid out and well-marked.

Changing ROMs with the Rompak attached to your computer will test your dexterity, as the bottom of the ROM socket lies too near the top of the computer--hold the ROM by the ends. Also, the "1" referred to in step 4 of the instructions is at the top right of the ROM socket. There's also one below and to the left, so watch it.

SYNTAX tested two EPROMS available for this product, one no longer available. The other contains Dan Tandberg's programs Timeblasters & Mazeball. Both require 16K of RAM.

Timeblasters is an arcade game with moving graphics. Your space ship travels to the right (we must be the good guys) and fires at enemies moving leftward. Actually, the background moves by you. Your moves are up, down and fire. But as you miss, time speeds up. With 6 levels of play, you can spend a lot of time getting good at it.

Mazeball extends the classic pong game by bouncing the ball through one of seven mazes. All you gotta do is keep the ball bouncing--HA!

**REUSABLE LOOPS--8K/1K**

You can shorten and clarify some of your programs by using one loop and several flag variables to perform related operations. For a sample, let's take a utility that creates, modifies, moves, checks, & prints a ten-byte MC routine.

You could write separate loops for each operation. But, since we always need 10 steps, one FOR-NEXT sequence (100 & 190) will do. Once inside the loop, we do some things on every pass, so we put them first at lines 102-107. Next we test the flag variable, K$, to see which of the choices we want to execute this time. If we cannot complete the task in one statement, we use a GOSUB to a **lower** line number. When we finish, we send the program back to our elementary menu to choose the next step.

This sample program also includes several methods to save memory. Single-letter variable names, a space variable (S$), and tokens in the menu cut the memory required for this program. You can cut more by substituting variables for numbers, then assigning values to the variables in command mode.

Before you enter this program, set RAMTOP to 17376 (16514+862) on your ZX/TS. This value corresponds to RAMTOP for Syntactic Sum in 1K. You can now load ten bytes into the REM statement and manipulate them. Using the POKE option, you over-write 10 bytes of Syntactic Sum.

When you enter this program, use only keywords following the colon in line 2. When you operate the program, just touch the key that controls the keyword--O for POKE--and the program responds.

One feature needed here, but not implemented, is a test of K$ for keys not on the menu. If you push an unflagged key, the program doggedly traverses the loop ten times, doing nothing, then returns the menu message. SYNTAX would love to see a memory-efficient way

to test for "none of the above" in an arbitrary menu.

INPUT lets you enter decimal code that will transform the REM statement to a short machine-code routine. You see the address, put in the code, see the code next to the address, and proceed. Enter 0 to create a NOP, or 201 to for a return, in spaces you don't use.

LPRINT lists the byte number, REM address, code in REM, MC address above RAMTOP, and content of that address to your printer.

PRINT generates the same display on your monitor or TV.

POKE takes the bytes from the REM statement and inserts them 862 bytes higher, above the RAMTOP you set prior to loading the program.

STOP lets you break out of the program to perform other operations of your choice.

To alter the BASIC program for Spectrum or 2068 operation, locate the beginning address of program space, add 5 and substitute the result for the constant 16514. PEEK 23635+256*PEEK 23636 gives the address for your 2068 or Spectrum. Set RAMTOP where you want, then change the constant 862 to reflect the difference in REM and RAMTOP addresses.

Spectrum and 2068 users gain nothing by storing machine code in REM statements; these machines let you SAVE machine code. But these instructions will let you try this reusable loop example.

You can expand this program to handle up to 32 bytes by expanding the REM statement and changing the upper value of I in line 100. Do not make those changes until the short version works. This program is slow and will annoy you during testing if you also make it long.

Expanding the concept, you can use several flag variables and more complex tests to make user-friendly routines with one master loop, but many functions. Arrange the tests (IF statements) so the most likely choice is tested first.

```
   1 REM XXXXXXXXXX
   2 PRINT "CHOOSE: INPUT LPRINT
 PRINT POKE OR STOP "
   3 PAUSE 4E4
   4 LET K$=INKEY$
   5 IF K$="" THEN GOTO 4
   6 CLS
   7 LET S$=" "
   8 GOTO 100
   9 PRINT R;S$;
  10 INPUT D
  11 POKE R,D
  12 PRINT D
  13 RETURN
 100 FOR I=0 TO 9
 102 LET R=I+16514
 104 LET M=R+862
 106 LET A$=STR$ I+S$+STR$ R+S$+
STR$ PEEK R
 107 LET B$=STR$ M+S$+STR$ PEEK
M
 110 IF K$="P" THEN PRINT A$,B$
 120 IF K$="S" THEN LPRINT A$,B$
 130 IF K$="O" THEN POKE M,PEEK
R
 140 IF K$="I" THEN GOSUB 9
 150 IF K$="A" THEN STOP
 190 NEXT I
 199 GOTO 2
SYNTACTIC SUM:  24227, 8K ROM
```

**RAND AND AUTORUN**

RAND will not work properly on ZX/TS machines if the program RUNs automatically when LOADed. Type in this program and SAVE via GOTO 40:

```
  10 RAND
  20 PRINT RND
  30 GOTO 20
  40 SAVE "RANDO■"
  50 RUN
SYNTACTIC SUM:  2842, 8K ROM
```

Now LOAD "RANDOM" and watch the numbers on the screen. LOAD again and you will see the same sequence! RAND works by counting the frames displayed between the time the program started running and the execution of RAND. When RUN automatically, this number is always the same. Using 50 GOTO 10 instead of RUN yields the same result. To solve this problem, add a PAUSE before RAND, so your program looks like this:

```
  10 RAND
  20 PRINT RND
  30 GOTO 20
  40 SAVE "RANDO■"
  44 PRINT "READY? (HIT ENTER)"
  46 PAUSE 4E4
  48 CLS
  50 RUN
SYNTACTIC SUM:  5278, 8K ROM
```

Harold Miller, Ph.D., Clayton GA

## TS2068 CONNECTOR PINOUTS

This information, from TIMEX Technical Memo #6, is supplied by TIMEX for publication by SYNTAX.

**Boldface** indicates active low or inverted signals (normally indicated via an overline). The letter B appended to the end of a signal name indicates the TS2068 buffers the signal.

REAR EDGE CARD CONNECTOR

| Solder Side | | Component Side | |
|---|---|---|---|
| Sig GND | 1B | 1A | Sig GND |
| SPK/TAPE | 2B | 2A | EAR |
| +15V | 3B | 3A | A7RB |
| +5V | 4B | 4A | D7 |
| Unused | 5B | 5A | DZIN |
| Slot | 6B | 6A | Slot |
| Pow GND | 7B | 7A | DØ |
| Pow GND | 8B | 8A | D1 |
| Ø | 9B | 9A | D2 |
| AØ | 10B | 10A | D6 |
| A1 | 11B | 11A | D5 |
| A2 | 12B | 12A | D3 |
| A3 | 13B | 13A | D4 |
| A15B | 14B | 14A | **INT** |
| A14B | 15B | 15A | **NMI** |
| A13B | 16B | 16A | **HALT** |
| A12 | 17B | 17A | **MREQB** |
| A11 | 18B | 18A | **IOROB** |
| A10 | 19B | 19A | **RDB** |
| A9 | 20B | 20A | **WRB** |
| A8 | 21B | 21A | **BUSAK** |
| A7 | 22B | 22A | **WAIT** |
| A6 | 23B | 23A | **BUSRQ** |
| A5 | 24B | 24A | **RESET** |
| A4 | 25B | 25A | **M1** |
| DZOUT | 26B | 26A | **RFSHB** |
| R | 27B | 27A | **EXROM** |
| G | 28B | 28A | **ROSCS** |
| B | 29B | 29A | **BE** |
| BUSISO | 30B | 30A | IOA5 |
| VIDEO | 31B | 31A | SOUND |
| Sig GND | 32B | 32A | Sig GND |

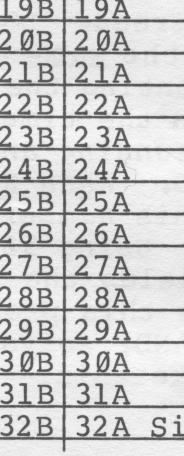
Pins 4-26 comprise the ZX/TS compatible pins. Use a 64 pin Ø.1" dual readout edge card connector to mate with this card edge. Case clearance: Ø.2Ø" (top), Ø.25" (bottom), and Ø.15" (sides).

ROS (a/k/a DOCK, TCC) CONNECTOR

| Solder | | Component | |
|---|---|---|---|
| A14B | 1 | 2 | +5V |
| A12 | 3 | 4 | A13B |
| DØ | 5 | 6 | D7 |
| D1 | 7 | 8 | AØ |
| D2 | 9 | 1Ø | A1 |
| D6 | 11 | 12 | A2 |
| D5 | 13 | 14 | A3 |
| D3 | 15 | 16 | A15B |
| D4 | 17 | 18 | **MREQB** |
| **IOROB** | 19 | 2Ø | A7RB |
| **RDB** | 21 | 22 | **M1** |
| **WRB** | 23 | 24 | A8 |
| A7 | 25 | 26 | A9 |
| A6 | 27 | 28 | A1Ø |
| A5 | 29 | 3Ø | A11 |
| A4 | 31 | 32 | **RFSHB** |
| **BE** | 33 | 34 | **EXROM** |
| **ROSCS** | 35 | 36 | GND |

ROS stands for ROM Oriented Software; TCC stands for Timex Command Cartridge. Use a 36 finger Ø.1" double sided edge card with a slot between pins 4 and 6 to mate with this connector. Cartridge bay dimensions: 2.25" (width at bottom), 2.55" (width at top), Ø.45" (height), and 3.35" (depth, including edge card fingers).

JOYSTICK CONNECTOR




| Pin | STICK | Signal | Meaning |
|---|---|---|---|
| 1 | 1 | **DIR1** | Up |
| 2 | 2 | **DIR2** | Down |
| 3 | 4 | **DIR3** | Left |
| 4 | 8 | **DIR4** | Right |
| 5 | | Unused | |
| 6 | 1 | **BUTTON** | Button Input |
| 7 | | +5V | +5V DC Power |
| 8 | | RDSTB | Read Strobe |
| 9 | | Unused | |

(See pp 173-5, 2068 Manual)

Use a female 9-pin D connector (DB9S, Atari Standard) to mate with this. The value STICK returns appears above. STICK reads through the 8912 sound chip I/O port. The actual bit value for the button on this port is 128.

SIGNAL NAMES AND MEANINGS

| Symbol | Meaning |
|---|---|
| Signal GND | Logic Ground Ref |
| Power GND | Power Supply Ground |
| +15V | +15V DC Power |
| +5V | +5V DC Power |
| SPKR/TAPE OUT | Tape MIC jack signal |
| EAR | Tape EAR jack signal |
| R | Red Color (TTL) |
| G | Green Color (TTL) |
| B | Blue Color (TTL) |
| VIDEO | Composite Video |
| **Ø** | System clock |
| A0-A12 | Address Lines 0-12 |
| A13B-A15B | Address Lines 13-15 |
| A7RB | Refresh Addr bit 7 |
| D0-7 | Data Lines 0-7 |
| BUSISO | Bus Isolate |
| DZIN | Daisy Chain In |
| DZOUT | Daisy Chain Out |
| **INT** | Interrupt Request |
| **NMI** | Non-maskable Intrpt |
| **HALT** | CPU Halt Output |
| **MREQB** | Memory Request |
| **IORQB** | Input/Output Request |
| **RDB** | Read |
| **WRB** | Write |
| **BUSAK** | Bus Acknowledge |
| **WAIT** | CPU Wait Output |
| **BUSRQ** | Bus Request |
| **RESET** | CPU Reset Input |
| **M1** | CPU M1 State Output |
| **RFSHB** | Refresh |
| **EXROM** | Extension ROM Enable |
| **ROSCS** | ROS Chip Select |
| **BE** | Bank Enable |
| IOA5 | 8912 I/O Port bit 5 |
| SOUND | 8912 Sound Output |

BUSISO tristates all buffered signals (those ending in B). IOA5 is the 8912 I/O port bit not used by the joystick circuitry. RGB color signals do not include sync (sync must be stripped off VIDEO).

**NOT ENTIRELY CLEAR--8K/1K**

Enter this line by hitting 1, CLEAR, cursor back, REM, NOT, /. Execute via RAND USR 16514.

```
1 REM NOT / CLEAR
```

Dan Tandberg, Albuquerque NM

**BIORHYTHMS--8K/16K**

I wrote this program as a result of a great disappointment I experienced after purchasing a Biorhythms program from one of the prominent software companies. The program did not print an accurate set of curves, and did not print a mathematically correct result.

I developed a printing routine first, which works on a PLOT, PRINT, UNPLOT basis, allowing a sine plot made of letters. The positive half of the curve usually prints first, then the rest of the curve in reverse (negative STEP).

Biorhythms computes time (T) in days and divides it by each cycle length to get the number of cycles since birth. It decides where to print each curve by converting the fraction of each cycle remaining to X PLOT coordinates (J) relative to the date line. The date line displays 2 pixels offset (column 16) to make it read accurately.

With 15 days on each side of the graph date, the completed chart represents a 31-day time spread, Relevant information appears at the top and bottom of the display, for a permanent record if you COPY.

Each date displays after INPUT. After you enter a name, Biorhythms goes into fast mode, usually making the time and offset computations in under 3.5 seconds. The graph printing, taking about a minute and a half, is rather interesting to watch (you wonder where the next curve will hit).

After typing the program, SAVE it with GOTO 1000. It will run as soon as SAVEing completes and after LOADing. Prompts are adequate, but if the program stops a simple "GOTO 150" will bring it right back.

Important variables:

T = Time in days
W = Number of cycles since birth
J = Sets start pt of sin print
L = Sets start pt of back print

Lines 5-45.....Intro display
Lines 145-275....Prompts and Input
Lines 297-360....Graph Print + Info
Lines 370-600....Sin Print P,E,I
Lines 610-710....More prompts and terminate display
Lines 820-885....Time Computation
Lines 890-986....X-Axis Offset Computations

This program uses up about 6.2K of RAM. I have an enhanced version with more user-friendliness and error-trapping features that also prints out a compatibility factor between two persons when given the birth dates of each, within a 10% range for each curve. It uses a little more than 15K of RAM and includes a brief explanation of biorhythm theory.

I will furnish the extended 15K version by mail to anyone for $10.00 post paid.

Doug McRoy
5 Pfister St
Laurel, MD 20707

```
  3 REM BIORHYTHM PROGRAM
  5 PRINT AT 3,8;"
  "
  6 PRINT AT 4,8;"
  "
  7 PRINT AT 5,8;"
  "
  8 PRINT AT 6,8;"
  "
  9 PRINT AT 7,8;"
  "
  10 PRINT AT 8,8;"
  "
  11 PRINT AT 9,8;"
  "
  12 PRINT AT 11,1;"
  "
  13 PRINT AT 12,1;"
  "
  14 PRINT AT 13,1;"
  "
  15 PRINT AT 14,1;"
  "
  16 PRINT AT 15,1;"
  "
  17 PRINT AT 16,1;"
  "
  18 PRINT AT 17,1;"
  "
  20 FOR N=1 TO 64 STEP 2
  25 PLOT N,22+20*SIN (N/32*PI)
  30 NEXT N
  35 PRINT AT 21,0;"BY DOUG MCRO
Y 1983"
  40 FOR I=1 TO 100
  45 NEXT I
  50 CLS
 145 REM INPUT PROMPTS
 150 CLS
 155 PRINT AT 5,0;"
                  "
 160 PRINT AT 5,6;"FOR BIORHYTHM
 CURVES:"
 165 PRINT AT 7,0;"
                  "
 170 PRINT AT 10,0;"ENTER BIRTH
DATE;"
 175 PRINT AT 11,5;"MONTH, DAY,
AND YEAR."
 180 PRINT AT 14,0;"ENTER EACH N
UMBER SEPARATELY."
 185 INPUT M1
 190 INPUT D1
 195 INPUT Y1
 200 PRINT AT 18,0;M1;"/";D1;"/"
;Y1
 210 PRINT AT 10,0;"
                   "
 215 FOR I=1 TO 10
 220 NEXT I
 225 PRINT AT 10,0;"NOW ENTER DE
SIRED DATE:"
 235 INPUT M2
 240 INPUT D2
 245 INPUT Y2
 250 PRINT AT 19,0;M2;"/";D2;"/"
;Y2
 255 PRINT AT 11,5;"
                   "
 260 PRINT AT 10,0;"
                   "
 263 PRINT AT 14,0;"
                   "
 265 FOR I=1 TO 15
 267 NEXT I
 270 PRINT AT 10,0;"NOW ENTER NA
ME
                   "
 275 INPUT Z$
 280 CLS
 285 FAST
 290 GOSUB 815
 292 REM GRAPH PRINT+INFO
 293 SLOW
 294 CLS
 297 PRINT AT 12,1;"PAST";AT 12,
26;"FUTURE"
 300 PRINT AT 14,4;"EACH DOT EQU
ALS ONE DAY."
 301 PRINT AT 16,6;"(A 31 DAY
GRAPH)"
 303 PRINT AT 10,0;"
                   "
 304 FOR N=1 TO 31
 305 PRINT AT 11,N;"
 "
 310 NEXT N
 315 PRINT AT 14,4;"
                   "
 325 PRINT AT 14,2;"VERTICAL LIN
E";AT 14,17;"IS GRAPH DATE."
 327 FOR N=1 TO 19
 330 PRINT AT N,16;"
 "
 335 NEXT N
 336 FOR I=1 TO 20
 337 NEXT I
 340 PRINT AT 14,0;"
   ";AT 14,17;"                "
```

```
 341 PRINT AT 16,6;"
     "
 342 PRINT AT 12,1;"    ";AT 12,
26;"        "
 345 PRINT AT 20,0;Z$
 350 PRINT AT 21,0;"BORN ";M1;"/
";D1;"/";Y1
 355 PRINT AT 0,0;"BIORHYTHM FOR
";AT 0,13;"(DATE)  ";M2;"/";D2;"/
";Y2
 360 PRINT AT 20,16;"DAYS OLD=";
T
 368 REM SIN PRINT PHY
 370 LET I=23
 375 PRINT AT 21,16;"
 380 LET L=J-2*I
 385 FOR N=0 TO 63 STEP 2
 390 IF J+N>61 THEN GOTO 420
 395 PLOT J+N,22+18*SIN (N/I*PI)
 400 PRINT "
 405 UNPLOT J+N,22+18*SIN (N/I*P
I)
 410 NEXT N
 420 FOR N=43 TO 46-((32-(64-J)/
2)*2) STEP -2
 425 PLOT L+N,22+18*SIN (N/I*PI)
 430 PRINT "
 435 UNPLOT L+N,22+18*SIN (N/I*P
I)
 440 NEXT N
 447 GOSUB 920
 449 REM SIN PRINT EMO
 450 LET I=28
 455 PRINT AT 21,16;"
 460 LET L=J-2*I
 465 FOR N=0 TO 63 STEP 2
 470 IF J+N>61 THEN GOTO 500
 475 PLOT J+N,22+18*SIN (N/I*PI)
 480 PRINT "
 485 UNPLOT J+N,22+18*SIN (N/I*P
I)
 490 NEXT N
 495 PRINT
 500 FOR N=53 TO 56-((32-(64-J)/
2)*2) STEP -2
 505 PLOT L+N,22+18*SIN (N/I*PI)
 510 PRINT "
 515 UNPLOT L+N,22+18*SIN (N/I*P
I)
 520 NEXT N
 527 GOSUB 955
 529 REM SIN PRINT INT
 530 LET I=33
 535 PRINT AT 21,16;"
"
 540 LET L=J-2*I
 545 FOR N=0 TO 63 STEP 2
 550 IF J+N>61 THEN GOTO 580
 555 PLOT J+N,22+18*SIN (N/I*PI)
 560 PRINT "
 565 UNPLOT J+N,22+18*SIN (N/I*P
I)
 570 NEXT N
 580 FOR N=63 TO 66-((32-(64-J)/
2)*2) STEP -2
 585 PLOT L+N,22+18*SIN (N/I*PI)
 590 PRINT "
 595 UNPLOT L+N,22+18*SIN (N/I*P
I)
 600 NEXT N
 605 PRINT AT 21,16;"
   "
 610 REM PROMPTS
 615 PRINT AT 21,20;"COPY? Y OR
N"
 620 LET Z$=INKEY$
 625 INPUT Z$
 630 IF CODE Z$=62 THEN COPY
 635 IF CODE Z$=51 THEN GOTO 643
 640 IF CODE Z$<>62 OR CODE Z$<>
51 THEN GOTO 625
 643 PRINT AT 21,0;"          R
UN PGM AGAIN? Y OR N"
 645 LET Z$=INKEY$
 650 INPUT Z$
 655 IF CODE Z$=62 THEN GOTO 150
 660 IF CODE Z$=51 THEN GOTO 675
 665 IF CODE Z$<>62 OR CODE Z$<>
51 THEN GOTO 650
 670 REM TERMINATION DISPLAY
 675 CLS
 680 PRINT AT 12,7;"HAVE A GOOD
DAY..."
 685 FOR I=1 TO 25
 690 NEXT I
 695 FOR I=1 TO 13
 700 SCROLL
 705 NEXT I
 710 STOP
 815 REM TIME PERIOD
 820 LET P$="303232332323"
 825 LET T=(Y2-Y1)*365
 830 FOR I=1 TO M1-1
 835 LET T=T-CODE P$(I)
 840 NEXT I
 845 FOR I=1 TO M2-1
 850 LET T=T+CODE P$(I)
 855 NEXT I
 860 LET T=T+D2-D1
 865 FOR I=Y1 TO Y2
 870 IF 4*INT (I/4)=I THEN LET T
=T+1
 875 NEXT I
 880 IF (Y1=Y2 AND M1<3 AND M2<3
) OR M1>2 THEN LET T=T-1
 885 LET T=T+1
 887 REM X-AXIS OFFSET PHY
 890 LET W=T/23
 895 LET W=ABS W+INT W
 900 IF INT W>0 THEN LET W=ABS W
-INT W
 905 LET J=W*46
 910 IF J<=30 THEN LET J=30-J
 915 IF J>30 THEN LET J=46-(J-30
)
 917 RETURN
 920 REM X-AXIS OFFSET EMO
 925 LET W=T/28
 930 LET W=ABS W+INT W
 935 IF INT W>0 THEN LET W=ABS W
-INT W
 940 LET J=W*56
 945 IF J<=30 THEN LET J=30-J
 950 IF J>30 THEN LET J=56-(J-30
)
 953 RETURN
 955 REM X-AXIS OFFSET INT
 960 LET W=T/33
 965 LET W=ABS W+INT W
 970 IF INT W>0 THEN LET W=ABS W
-INT W
 975 LET J=W*66
 980 IF J<=30 THEN LET J=30-J
 985 IF J>30 THEN LET J=66-(J-30
)
 986 IF J>63 THEN LET J=J-66
 990 RETURN
1000 SAVE "BIORHYTH"
1005 RUN
SYNTACTIC SUM: 29522, 8K ROM
```

**DEAR EDITOR:**

For a TS2068 version of Dave Wood's HIGH LINE NUMBERS (SYNTAX Dec.83 p4) you need only add two PEEKs which locate the line number bytes in memory. Line numbers store as high byte followed by low, reversed compared to most other 16-bit quantities.

On your TS2068, enter as line 1 the line which will be last in the listing (highest line number). Then use this direct command:
LET a=PEEK 23635+PEEK 23636*256: POKE a,(hi byte): POKE a+1,(lo byte)
Write down decimal values of POKEd lines (high byte*256+low byte); any line numbered higher than 16383 (63*256+255) won't show on-screen.

To add more high-number lines, enter the next highest line in the listing as line 1. As long as RUN or CLEAR have not been used after defining a in memory, use the direct command:
POKE a,(hi byte):POKE a+1,(lo byte)
The highest possible line number is 32767 (hi byte=127 & lo byte=255).

Only lines numbered less than 16383 will function with a normal RUN command, GO TO, or GO SUB. Lines numbered from 16384 to 32767 will function only by a direct RUN or GO TO and then execute only the statement contained in that line--useful only as a curiosity or to store listings off-screen. When lines numbered 1-9999 are pushed off-screen by a line numbered from 16384 to 32767, and a GO TO is then made to the high-numbered line, it will be processed along with the normal lines which follow it in the listing order.

To EDIT the last line entered, if it doesn't show on-screen, enter the direct command POKE a,1. Lines 10,000 to 16383 may be brought down with EDIT, re-numbered to less than 10,000, revised, and POKEd back to a high number. You can calculate the location of line number bytes after the first line in a listing, but otherwise the only way to EDIT a line POKEd above 9999 is to delete all preceding lines in the listing, both on- and off-screen.

For locating start of 2nd line:

```
1 LET a=PEEK 23635+PEEK 23636*256
2 PRINT "Demo"
3 FOR n=a TO a+1000
4 IF PEEK n=13 THEN LET a=n+1:
  GO TO 10
5 NEXT n
10 POKE a,10
20 LIST
```

In comment on the "New image" Timex now has for their 1-800-24-TIMEX customer support service, in contrast to the rather vague responses most of us received in the past, they very helpfully provided me with a schematic, I/O map, and pin-out as well as an approximate availability date on the forthcoming TS2000 Advanced Programming Concepts Manual. I greatly appreciate this kind of support and, judging from the amount of time it took me to get a free line on the TIMEX number, I am sure there are many others.

Robert Hartung, Palmyra, NY

SYNTAX (Aug.82 p19) describes the illegal line number 3E00H (15872) as the marker for the top of the GOSUB stack in ZX/TS machines. The Spectrum uses the same marker, but we don't know about the 2068.--KO

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MAINTAINING THE ZX81

Calling 1-800-24-TIMEX seems an exercise in futility. After 4 days of 20-30 calls per day, I gave up. Only twice did I get a ring. On these two occasions the nice recorded voice told me "everyone is busy, please be patient, someone will soon help you." In about ten seconds, the line disconnected.

I was trying to call about a replacement ULA chip for my TS1000, out of warranty, modified circuit

board system. I guess I zapped it with body electrostatic charge, although it broke out while typing in a program.

Testing the system using an oscilloscope I found no clocked signals associated with ROMCS and RAMCS (6.5 Mhz clock was OK).

Since contacting TIMEX was a total failure, I then spent about $30.00 on phone calls, eventually locating a TS1000. Believe me, the inventory of TS1000 computers in the US is very close to zero. If Syntax readers want to obtain a "spare" for their upgraded ZX/TS systems, I advise them to act now. Sunset Electronics (415/665-8330), still has a few at $29.95 as of this writing. Some twenty other suppliers I called have none and cannot get more. For $29.95 plus shipping I can get a spare set of ULA and ROM chips for my future needs. I suspect a spare ULA chip would, itself, cost up to $20.00, if one could be found.

US replacements for British transistors: Sylvania ECG-123AP replaces ZTX-313; ECG-391 replaces ZTX-750 and ZTX-752. Almost any "signal diode," such as 1N34A, will replace any diode on the board. The crystal located in the circuit between pin 35 of the ULA chip and pin 26 of the Z80 CPU, can be replaced with an ordinary JAN 6.5 MHz crystal (smallest metal can crystal with axial leads). All other parts on the circuit board, except the ULA and ROM chips, may be purchased off the shelf.

Bill Jones, Panama City, FL

Use 1N914 or 1N4148 diodes for the higher forward drop of Silicon.--KO

---

I think your readers would appreciate the answers to the following questions:

1) Why does the Timex 2040 printer emit heat from its top vent even though I have pressed the "OFF" button and haven't used the printer in days?

2) The new Timex 2068 computer only seems to have 38K available for programming (16K "BASIC" and 22K "VARS"); why?

3) What peripherals can be used safely with the Timex 1500 computer? (e.g. when I plugged in my 16K Sinclair Rampak the computer went blank and I had to send it back to the supplier. I hear there are problems if you use a Memopak 64K and other hardware <u>not</u> manufactured by Timex).

Wm. McConaghey, Pembroke Pines, FL

TS2040 printers emit heat when off because the switch doesn't turn off the 24V printhead power.

Most computers use some RAM to perform functions that permit your programs to operate. Sharon Aker reports that the Commodore 64 also allows only 38911 bytes for users compared with 38652 in the TS2068. Page 254 of the user's manual shows how a 2068 uses memory. I know of no 16K BASIC limit in 2068's, but SYNTAX has discussed it at length for ZX/TS operation, including ways to get around it. (Sep.82 p13; SQ Summer 83 p47 & Nov.83 p12)

TS1500 computers will operate with any accessory that doesn't use RAMCS to disable the internal RAM. On 1500's, RAMRM moves the internal RAM to 32-48K and leaves it active. Sinclair RAMpaks do work, and Byte-Back memories and modules operate (SYNTAX Nov.83 p14). We hear that some 1500's would not drive Timex printers, and the 2040 printer will destroy the data-line timing. See SYNTAX Nov.83 p2 for details of the fix for 2040-generated problems--KO

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**PLEASE:** Check SYNTAX back issues before you **write.** We can't reply to individual technical letters or republish data. We must devote our resources to new problems. Phone 617/456-3661 or buy a Works.

**RENUMBER--8K/16K**

Utility programs for renumbering the lines of BASIC programs facilitate merging with other programs, spreading out line numbers to make room for additional lines, and neatening up finished programs. Changing line numbers is easy, but a useful renumbering utility must also fix the destination line numbers in GOTOs and GOSUBs, a more difficult task. This program does the job, although slowly since it is written almost entirely in BASIC.

If you have a program merging utility, RENUMBER can be appended to, and used to renumber, any BASIC program of less than about 12,000 bytes (provided its line numbers initially extend no farther than 9722). Even without a merge utility, RENUMBER can still be useful. LOAD it first, then key in your main program as you develop it.

Note the partial Syntactic Sums given at several points in the listing. When typing in RENUMBER, get a Syntactic Sum at each of these checkpoints and correct any mistakes before proceeding. This will reduce the number of lines you need to search to find your error. Since this is a self-starting program, the final Syntactic Sum reflects the program after it has been SAVEd and then LOADed from cassette.

After typing in RENUMBER, SAVE it to cassette with the command GOTO 9976. Whenever LOADed it will self-start and execute Lines 9978 to 9994, storing two machine language subroutines into high memory. You must set RAMTOP to address 32512 or lower, and NEW to reinitialize the machine stack prior to loading RENUMBER. The machine code loads at addresses 32512 to 32542. It is relocatable, but this requires appropriate changes in Lines 9890, 9892, 9904, 9982, 9990, and 9996.

RENUMBER ignores any GOTO or GOSUB whose destination line number does not begin with a digit. With this exception, RENUMBER correctly handles the renumbering of all (or any part of) a BASIC program.

You must specify what part of the target program is to be renumbered, the new starting line number, and the desired increment between line numbers. If only a portion of the target program is renumbered the user must be very careful in selecting the new starting number and the increment. The line numbers that result from renumbering must be consistent with (i.e., in correct numerical order) the rest of the program, otherwise the resulting program may crash. Note that entering 0 in response to the first prompt renumbers the entire program.

RENUMBER starts by searching the entire program, line by line, (main search routine starts at line 9826) looking for IF, GOTO, or GOSUB statements. When an IF statement is found, the rest of that statement is scanned to see whether it contains a GOTO or GOSUB. If so, the program jumps to the GOTO/GOSUB processing routine at Line 9848. Otherwise it jumps back to the main search routine. Line 9842 avoids misinterpreting bytes within floating point numbers as GOTO or GOSUB tokens, ignoring 5 bytes following code 126.

The core of the program begins at line 9848, the GOTO/GOSUB processing routine. After the token for GOTO or GOSUB Sinclair BASIC puts the codes for the decimal digits of the destination line number, then a "number" token (code 126), then five bytes holding the number in floating-point binary form, then a newline character (code 118). Lines 9848 to 9860 put the characters following GOTO or GOSUB into D$ if it is a number, but if the first destination character is non-numeric it jumps back to the main search routine.

Lines 9862 to 9874 determine whether or not the number in D$ is a bona-fide line number within the part of the program being renumbered. If not, RENUMBER jumps back to the main search routine, without making any changes. Otherwise, it determines what position that line occupies in the section of the program being renumbered and puts that position number into variable DC. The new line number will be the position number times the step size plus the new starting line number.

Both the old line number and the new line number may have anywhere from one to four digits (1 to 9722). If the new number is shorter than the old, lines 9886 and 9888 put enough leading zeroes in front of the new number to make it the same length as the old. But when the new number is longer than the old, RENUMBER makes room for it in the program line by moving the rest of the target program (including all of RENUMBER itself) upward in memory by one, two, or three bytes. There is a suitable "make room" routine already available in the system ROM, at address 2459. It moves the memory block starting at the address pointed to by register pair HL and ending at the end of the program, one byte up, adjusting the system variables accordingly.

Lines 9890 and 9892 POKE into memory locations 32512 and 32513 the address to load into HL. The FOR...NEXT loop beginning at line 9894 makes one or more USR calls to the machine code routine at address 32514, which in turn loads the stored address into register pair HL and calls the ROM routine to "make room". This loop also adjusts the length bytes of the newly expanded program line.

The "make room" routine moves the bytes of the BASIC line that called it, resulting in the return address being off by one byte and, normally, a crash. BASIC can easily be tricked into returning to the correct address: Line 9902 gets the address of Line 9904 from system variable NXTLIN and POKEs the length of line 9904 so it is one byte too high (15 instead of 14). After the "make room" routine executes, it returns to the location 15 bytes after line 9904. Line 9904 is 14 bytes long, plus the one byte it has been moved by the "make room" routine, so the USR routine returns to the correct address. Immediately after each USR call the phony length of 15 is corrected to the proper figure of 14 by Line 9906. This line gets the address of line 9908 from system variable NXTLIN and looks backward 77 bytes (the total length of Line 9906 plus part of Line 9904) to the address of the low length byte of line 9904.

Lines 9910 to 9914 POKE the codes for the decimal digits of the new line number into the program line. Then Line 9918 gets the address of program variable ND from system variable VARS. Variable ND, originally defined in line 9738, contains the value of the new line number in floating-point form, so Lines 9920 to 9924 simply copy those five bytes into the program line, over-writing the original number. This process repeats for each line in the program containing GOTO or GOSUB. Finally, lines 9940 to 9950 renumber the lines within the range initially specified.

You can erase RENUMBER completely with these two commands:

GOTO 9996 ENTER
9724 ENTER

Line 9996 invokes the machine code routine at address 32521, which calculates the total length of RENUMBER and POKEs that number minus 4 into the length bytes of line 9724. Thus when you delete line 9724 the entire RENUMBER program goes with it, leaving your finished main program intact.

C. C. Stalder, Orlando FL

```
9724 STOP
9725 REM ****RENUMBER****
9726 REM BY C. C. STALDER
9728 REM >>NOTE<< THIS ENTIRE
PROGRAM LINES 9724 TO 9999 CAN
BE DELETED BY TWO COMMANDS:
       GOTO 9996 ENTER
       9724 ENTER
9730 REM
9732 REM RESERVE SPACE AT "VARS"
FOR CONVERTING EACH DESTINATION
LINE NUMBER TO FLOATING POINT
9734 CLS
9736 CLEAR
9738 LET ND=0
9740 PRINT "LOWEST LINE TO RENUM
BER? "
9742 PRINT "TO RENUM ENTIRE PROG
RAM, ENTER 0"
9744 INPUT LL
9746 IF LL<0 OR LL<>INT LL OR LL
>9722 THEN GOTO 9952
9748 IF LL<>0 THEN PRINT AT 0,26
;LL;AT 3,0;
9750 IF LL<>0 THEN GOTO 9762
9752 PRINT AT 0,26;"ALL";AT 3,0;
9754 LET LL=256*PEEK 16509+PEEK
16510
9756 LET HL=9722
9758 GOTO 9770
9762 PRINT "HIGHEST LINE TO RENU
MBER? ";
9764 INPUT HL
9766 IF HL<=LL OR HL<>INT HL OR
HL>9722 THEN GOTO 9952
9768 PRINT HL
9770 PRINT ,,"NEW NUMBER FOR LOW
 LINE? ";
9772 INPUT NL
9774 IF NL<1 OR NL<>INT NL OR NL
>9722 THEN GOTO 9952
9776 PRINT NL
9778 PRINT ,,"STEP SIZE DESIRED?
 ";
9780 INPUT SZ
9782 IF SZ<1 OR SZ<>INT SZ THEN
GOTO 9952
9784 PRINT SZ
9786 PRINT ,,"CHOOSE: ..(R)UN..(M
)ODIFY..(Q)UIT"
9788 PAUSE 4E4
9790 LET K$=INKEY$
9792 IF K$="R" THEN GOTO 9812
9794 IF K$="M" THEN GOTO 9734
9796 IF K$="Q" THEN GOTO 9992
9798 GOTO 9790
SYNTACTIC SUM SO FAR: 60304

9812 LET SA=16509
9814 IF 256*PEEK SA+PEEK (SA+1)=
LL THEN GOTO 9826
9816 IF 256*PEEK SA+PEEK (SA+1)>
LL THEN GOTO 9952
9818 LET SA=SA+4+PEEK (SA+2)+256
*PEEK (SA+3)
9820 GOTO 9814
9826 LET OP=16509
9828 IF 256*PEEK OP+PEEK (OP+1)>
9722 THEN GOTO 9940
9830 LET LA=OP+4
9832 IF PEEK LA=250 THEN GOTO 98
40
9834 IF PEEK LA=236 OR PEEK LA=2
37 THEN GOTO 9848
9836 LET OP=OP+4+PEEK (OP+2)+256
*PEEK (OP+3)
9838 GOTO 9828
9840 LET LA=LA+1
9842 IF PEEK LA=126 THEN LET LA=
LA+6
9844 IF PEEK LA=118 THEN GOTO 98
36
9846 IF PEEK LA<>236 AND PEEK LA
<>237 THEN GOTO 9840
SYNTACTIC SUM SO FAR: 31362
9848 LET LA=LA+1
9850 LET D$=""
9852 FOR N=LA TO LA+4
9854 IF PEEK N=126 THEN GOTO 986
2
9856 IF PEEK N<28 OR PEEK N>37 T
HEN GOTO 9836
9858 LET D$=D$+CHR$ PEEK N
9860 NEXT N
9862 IF VAL D$<LL OR VAL D$>HL T
HEN GOTO 9836
9864 LET DC=0
9866 LET DP=SA
9868 IF VAL D$<=256*PEEK DP+PEEK
 (DP+1) THEN GOTO 9880
9870 LET DP=DP+4+PEEK (DP+2)+256
*PEEK (DP+3)
9872 LET DC=DC+1
9874 GOTO 9868
9880 LET ND=DC*SZ+NL
9882 LET X$=STR$ ND
9884 IF LEN X$<LEN D$ THEN LET X
$="0"+X$
9886 IF LEN X$<LEN D$ THEN GOTO
9884
9888 IF LEN X$=LEN D$ THEN GOTO
9910
9890 POKE 32513,INT (LA/256)
9892 POKE 32512,LA-256*PEEK 3251
3
SYNTACTIC SUM SO FAR: 921

9894 FOR N=1 TO LEN X$-LEN D$
9896 LET TL=PEEK (OP+2)+256*PEEK
 (OP+3)+1
9898 POKE (OP+3),INT (TL/256)
9900 POKE (OP+2),TL-256*PEEK (OP
+3)
9902 POKE (PEEK 16425+256*PEEK 1
6426+2),15
9904 RAND USR 32514
9906 POKE (PEEK 16425+256*PEEK 1
6426-77),14
9908 NEXT N
9910 FOR N=0 TO LEN X$-1
9912 POKE (LA+N),CODE X$(N+1)
9914 NEXT N
9916 LET LA=LA+LEN X$+1
9918 LET VP=PEEK 16400+256*PEEK
16401+2
9920 FOR N=0 TO 4
9922 POKE (LA+N),PEEK (VP+N)
9924 NEXT N
9926 GOTO 9836
9940 IF 256*PEEK SA+PEEK (SA+1)>
HL THEN GOTO 9992
9942 POKE SA,INT (NL/256)
9944 POKE (SA+1),NL-256*PEEK SA
9946 LET NL=NL+SZ
9948 LET SA=SA+4+PEEK (SA+2)+256
*PEEK (SA+3)
9950 GOTO 9940
SYNTACTIC SUM SO FAR: 42169
```

```
9952 CLS
9954 PRINT "INVALID NUMBER.  PRE
SS ENTER    AND START OVER."
9956 PAUSE 4E4
9958 GOTO 9734
9976 SAVE "RENUMBER"
9978 FAST
9980 LET Z$="042000127205155009Z
0103325203720521600903503503523S
042012064167237082235027114043ll
5201"
9982 LET PA=32514
9984 FOR N=1 TO 87 STEP 3
9986 POKE PA,VAL Z$(N TO N+2)
9988 LET PA=PA+1
9990 NEXT N
9992 CLS
9993 LIST
9994 STOP
9996 RAND USR 32521
9999 GOTO 9992
SYNTACTIC SUM BEFORE SAVE: 62187
```

```
ADDR    7F00 00005    00006
DFILE   400C 00003    00016
ERASE   7F09 00010
MAKER   7F02 00006
```



```
                00001          ;RENUMBER MACHINE CODE
                00002
400C            00003 DFILE    EQU     16396
7F00            00004          ORG     32512
7F00 0000       00005 ADDR     DEFW    0              ;ADDRESS POKED IN BASIC
7F02 2A007F     00006 MAKER    LD      HL,(ADDR)      ;GET ADDRESS IN HL
7F05 CD9B09     00007          CALL    2459           ;CALL "MAKE ROOM"
7F08 C9         00008          RET                    ;BACK TO BASIC
                00009
7F09 21FC25     00010 ERASE    LD      HL,9724        ;FIRST LINE # IN RENUM
7F0C CDD809     00011          CALL    2520           ;LOOK UP ADDRESS
7F0F 23         00012          INC     HL             ;POINT HL TO HIGH
7F10 23         00013          INC     HL             ;TEXT LENGTH BYTE
7F11 23         00014          INC     HL             ;OF LINE 9724
7F12 EB         00015          EX      DE,HL          ;SAVE HL IN DE
7F13 2A0C40     00016          LD      HL,(DFILE)     ;HL=ADDRESS OF DFILE
7F16 A7         00017          AND     A              ;CLEAR CARRY FLAG
7F17 ED52       00018          SBC     HL,DE          ;HL=# PROG BYTES MINUS 3
7F19 EB         00019          EX      DE,HL          ;RECOVER LEN PTR IN HL
7F1A 1B         00020          DEC     DE             ;DE=# PROG BYTES MINUS 4
7F1B 72         00021          LD      (HL),D         ;CHANGE HI BYTE LEN 9724
7F1C 2B         00022          DEC     HL
7F1D 73         00023          LD      (HL),E         ;CHANGE LOW BYTE LEN 9724
7F1E C9         00024          RET                    ;BACK TO BASIC
```

## PI--8K/16K

This program can calculate PI to over 8000 decimal places-- but don't hold your breath. It takes over 12 hours for 512 digits! The algorithm uses base 100 arithmetic, storing each digit in one byte of a character string (codes 0-99). It is based on the Taylor series for the arctangent.

First PI prints out 8 digits, then it starts all over again and does 16, then 32, 64, etc. If you don't have a printer, change all the LPRINTs to PRINTs and add a STOP at line 6095. Go on to the next calculation with CONT.

Since the program allocates 12K of RAM for the accumulators A$(1), A$(2), and A$(3), CLEAR before SAVEing to avoid storing lots of variable space to tape.

Blanchard D. Smith
Alexandria VA

```
3.14159265358979323846264338327
50288419716939937510582097494459
23078164062862089986280348253421
17067982148086513282306647093844
60955058223172535940812848111745
02841027019385211055596446229489
54930381964428810975665933446128
47564823378678316527120190914564
85669234603486104543266482133936
07260249141273724587006606315588
17488152092096282925409171536436
78925903600113305305488204665213
84146951941511609433057270365759
59195309218611738193261179310511
85480744623799627495673518857527
24891227938183011949129833673362
```

```
  10 REM  PI TO 4,8,16,,,8192
DECIMAL PLACES
  20 LET T=100
  30 FOR J=2 TO 12
  40 LET N=2**J+1
  50 DIM A$(3,N)
  60 LET A$(1)=""
  70 LET A$(2)=""
  80 LET A$(2,1)=CHR$ 16
  90 LET D=5
 100 GOSUB 4700
 110 LET S=1
 120 LET D=25
 130 FOR E=1 TO 9999 STEP 2
 140 GOSUB 5000
 150 GOSUB 4700
 160 LET S=-S
 170 IF Z<>0 THEN NEXT E
 180 LET A$(2)=""
 190 LET A$(2,1)=CHR$ 4
 200 LET D=239
 210 GOSUB 4700
 220 LET S=-1
 230 FOR E=1 TO 9999 STEP 2
 240 GOSUB 5000
 250 GOSUB 4700
 260 LET S=-S
 270 GOSUB 4700
 280 IF Z<>0 THEN NEXT E
 290 GOSUB 6000
 300 NEXT J
 310 STOP
 320 CLEAR
 330 LET X$="PI"
 340 SAVE X$
 350 RUN
4700 LET A=0
4710 LET Z=0
4720 FOR K=1 TO N
4730 LET A=CODE A$(2,K)+A
4740 LET Q=INT (A/D)
4750 LET A$(2,K)=CHR$ Q
4760 LET R=A-D*Q
4770 LET A=R*T
4780 LET Z=Z OR (Q+R)
4790 NEXT K
4800 RETURN
5000 LET A=0
5100 FOR K=1 TO N
5110 LET A=CODE A$(2,K)+A
5120 LET Q=INT (A/E)
5130 LET A$(3,K)=CHR$ Q
5140 LET A=(A-E*Q)*T
5150 NEXT K
5160 LET C=0
5170 IF S<0 THEN GOTO 5240
5180 FOR K=N TO 1 STEP -1
5190 LET A=CODE A$(1,K)+CODE A$(
3,K)+C
5200 LET C=A>=T
5210 LET A$(1,K)=CHR$ (A-(T AND
C))
5220 NEXT K
5230 RETURN
5240 FOR K=N TO 1 STEP -1
5250 LET A=CODE A$(1,K)-CODE A$(
3,K)-C
5260 LET C=A<0
5270 LET A$(1,K)=CHR$ (A+(T AND
C))
5280 NEXT K
5290 RETURN
6000 LPRINT " "
6010 LET P$="3."
6020 FOR K=2 TO N-1
6030 LET X$="0"+STR$ CODE A$(1,K
)
6040 LET P$=P$+X$(LEN X$-1 TO )
6060 IF LEN P$<32 THEN NEXT K
6070 LPRINT P$
6080 LET P$=""
6090 NEXT K
6100 RETURN
SYNTACTIC SUM: 14842, 8K ROM
```

For the TS2068, translate with FIRSTLOADER (SYNTAX, Dec. 83), then delete lines 60 and 70, add 55, and replace 180:

```
  55 LET Z$="": FOR K=1 TO N: LE
T Z$=Z$+CHR$ 0: NEXT K: LET A$(1
)=Z$: LET A$(2)=Z$: LET A$(3)=Z$
 180 LET A$(2)=Z$
```

## KALEIDOSCOPE--8K/16K

I resorted to machine code in an effort to write a fast program to display a kaleidoscope pattern on the ZX/TS screen. The resulting images may be viewed on the screen and printed out at will.

In order to get random numbers for the plot locations in machine code, I used the FRAMES system variable (locations 16436 and 16437) to set a pointer into the ROM. The program reads bytes out of the ROM and increments the pointer for each random number. If the pointer goes too high, it is reset to 0. This method shows no visible signs of repetition.

To enter KALEIDOSCOPE, type in listing 1. Put 145 spaces after the message in line 1, and no space between "KALEIDOSCOPE" and "PRESS". Line 20 contains 32 spaces. RUN the program and enter the numbers in table 1. For each number, the display will show an address and wait for you to enter the contents. After you enter a number it will appear on the screen. If correct, hit ENTER, otherwise press any letter key and reenter the number. After entering all 144 numbers, the Syntactic Sum should be 29651.

Now delete lines 10-100 by entering each line number. Type in lines 10-50 as shown in listing 2.

Be sure you are in SLOW mode, then set your cassette to record and RUN. The program SAVEs automatically and RUNs when LOADed. When done SAVEing, the title will appear on the screen for a few seconds, and then the screen will begin flashing somewhat random patterns. Press any key and the main part of the program will begin. To print a copy of the screen, hit any key. You can save a picture on tape by changing line 30 to SAVE "KALEIDOSCOPE". The program stops if you press BREAK.

[This program can generate three-dimensional effects if you print out the screen twice with a small time for the pattern to change in between. Hold the output sideways and cross your eyes until the two patterns merge; some points appear to recede into the paper and some appear to jump out. --Ed.]

Scott H. McGurrin, Macedon NY

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 42 | 12 | 64 | 1 | 208 | 0 | 9 | 235 |
| 33 | 130 | 64 | 1 | 12 | 0 | 237 | 176 |
| 235 | 1 | 25 | 1 | 9 | 235 | 1 | 22 |
| 0 | 237 | 176 | 17 | 0 | 200 | 27 | 122 |
| 179 | 32 | 251 | 237 | 87 | 60 | 237 | 71 |
| 205 | 187 | 2 | 36 | 40 | 245 | 62 | 30 |
| 237 | 71 | 205 | 42 | 10 | 205 | 187 | 2 |
| 36 | 32 | 250 | 42 | 52 | 64 | 203 | 180 |
| 203 | 188 | 70 | 35 | 203 | 176 | 203 | 184 |
| 62 | 43 | 184 | 56 | 245 | 78 | 35 | 203 |
| 177 | 203 | 185 | 126 | 35 | 203 | 71 | 32 |
| 3 | 175 | 24 | 2 | 62 | 128 | 245 | 205 |
| 41 | 65 | 62 | 43 | 144 | 71 | 241 | 245 |
| 205 | 41 | 65 | 62 | 63 | 145 | 79 | 241 |
| 245 | 205 | 41 | 65 | 62 | 43 | 144 | 71 |
| 241 | 205 | 41 | 65 | 229 | 205 | 187 | 2 |
| 36 | 225 | 40 | 186 | 201 | 197 | 229 | 50 |
| 48 | 64 | 205 | 178 | 11 | 225 | 193 | 201 |

Table 1. Numbers to POKE

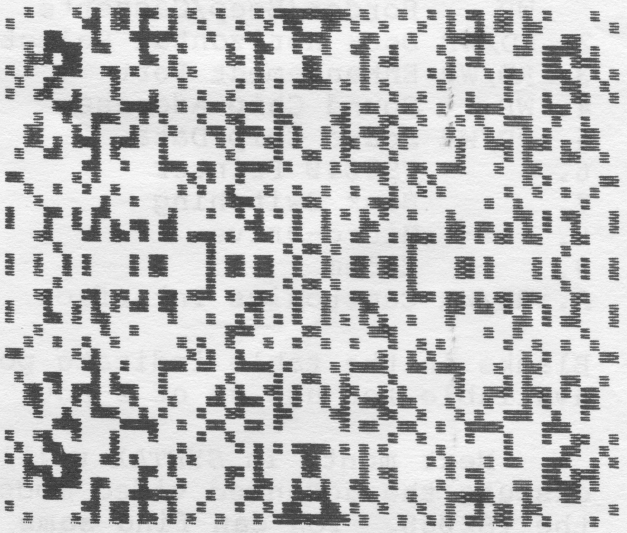
```
  1 REM KALEIDOSCOPEPRESS ANY K
EY TO BEGIN



 10 FOR X=16548 TO 16691
 20 PRINT AT 0,0;"                "
 30 PRINT AT 0,0;X,
 40 INPUT A
 50 PRINT A;"   "
 60 IF INKEY$<>"" THEN GOTO 60
 70 IF INKEY$="" THEN GOTO 70
 80 IF CODE INKEY$<>118 THEN GO
TO 30
 90 POKE X,A
100 NEXT X
SYNTACTIC SUM: 13143, 8K ROM
```

```
  1 REM KALEIDOSCOPEPRESS ANY K
EY TO BEGINE£RND↑50R  ▒ FOR 5▙RN
D↑£  GOSUB ▓ FOR ↑;↑▒ FOR ↑-  GO
SUB ▓) COS .?▓4 CLS GOSUB ?W GOS
UB ?LN ▓↑8C PRINT Y2 GOSUB ?LN E
▒LN ▓↑84 IF EORNDACS ▓ACS ▓?7ACS
 ▓ACS ▓YF▓S PRINT ?7ACS ▓ACS ▓▓/
↑Y▓ PRINT LN DINKEY$YF▓? LET PRI
NT LN DINKEY$YZ▓▓? LET PRINT LN D
INKEY$YF▓? LET LN DINKEY$ FAST L
N ▓↑8 LPRINT C▓TAN VAL FAST MKRN
DLN ▓" LPRINT AT TAN
 10 SAVE "KALEIDOSCOPE"
 20 LET A=USR 16548
 30 COPY
 40 LET A=USR 16601
 50 GOTO 30
SYNTACTIC SUM: 23177, 8K ROM
```

```
                00001   ;KALEIDOSCOPE MACHINE CODE
                00002
400C            00003 DFILE   EQU   16396
4034            00004 FRAMES  EQU   16436
4082            00005         ORG   16514
4082 2A0C40     00006 PRINT   LD    HL,(DFILE)
4085 01D000     00007         LD    BC,208
4088 09         00008         ADD   HL,BC
4089 EB         00009         EX    DE,HL
408A 218240     00010         LD    HL,16514      ;PRINT MESSAGE ON SCREEN
408D 010C00     00011         LD    BC,12
4090 EDB0       00012         LDIR
4092 EB         00013         EX    DE,HL
4093 011901     00014         LD    BC,281
4096 09         00015         ADD   HL,BC
4097 EB         00016         EX    DE,HL
4098 011600     00017         LD    BC,22
409B EDB0       00018         LDIR
409D 1100C8     00019 PAUSE   LD    DE,51200      ;TIMING LOOP
40A0 1B         00020 PLOOP   DEC   DE
40A1 7A         00021         LD    A,D
40A2 B3         00022         OR    E
40A3 20FB       00023         JR    NZ,PLOOP
40A5 ED57       00024 DISP    LD    A,I           ;DISPLAY SCRAMBLING
40A7 3C         00025         INC   A             ;ROUTINE
40A8 ED47       00026         LD    I,A
40AA CDBB02     00027         CALL  699           ;KEY PRESS?
40AD 24         00028         INC   H
40AE 28F5       00029         JR    Z,DISP
40B0 3E1E       00030 FIX     LD    A,30          ;RETURN TO NORMAL
40B2 ED47       00031         LD    I,A           ;DISPLAY
40B4 CD2A0A     00032         CALL  2602          ;CLS
40B7 CDBB02     00033 WAIT    CALL  699           ;WAIT UNTIL NO KEY
40BA 24         00034         INC   H
40BB 20FA       00035         JR    NZ,WAIT
40BD 2A3440     00036         LD    HL,(FRAMES)   ;POINTER INTO ROM
40C0 CBB4       00037 RESET   RES   6,H           ;TRIM OFF EXCESS BITS
40C2 CBBC       00038         RES   7,H
40C4 46         00039 VALS    LD    B,(HL)        ;RANDOM Y VALUE
40C5 23         00040         INC   HL
40C6 CBB0       00041         RES   6,B
40C8 CBB8       00042         RES   7,B
40CA 3E2B       00043         LD    A,43
40CC B8         00044         CP    B
40CD 38F5       00045         JR    C,VALS        ;GO BACK IF TOO HIGH
40CF 4E         00046         LD    C,(HL)        ;RANDOM X VALUE
40D0 23         00047         INC   HL
40D1 CBB1       00048         RES   6,C
40D3 CBB9       00049         RES   7,C
40D5 7E         00050         LD    A,(HL)
40D6 23         00051         INC   HL
40D7 CB47       00052         BIT   0,A
40D9 2003       00053         JR    NZ,UNPLOT
40DB AF         00054         XOR   A             ;0 FOR PLOT,
40DC 1802       00055         JR    DOPLOT        ;128 FOR UNPLOT
```

```
40DE 3E80      00056 UNPLOT  LD    A,128
40E0 F5        00057 DOPLOT  PUSH  AF          ;SAVE AF
40E1 CD0741    00058 PLOT1   CALL  PLOT        ;PLOT THE POINT
40E4 3E2B      00059         LD    A,43        ;GET SECOND POINT
40E6 90        00060         SUB   B
40E7 47        00061         LD    B,A
40E8 F1        00062         POP   AF
40E9 F5        00063         PUSH  AF
40EA CD0741    00064 PLOT2   CALL  PLOT        ;PLOT THE POINT
40ED 3E3F      00065         LD    A,63        ;GET THIRD POINT
40EF 91        00066         SUB   C
40F0 4F        00067         LD    C,A
40F1 F5        00068         PUSH  AF
40F2 F1        00069         POP   AF
40F3 CD0741    00070 PLOT3   CALL  PLOT        ;PLOT THE POINT
40F6 3E2B      00071         LD    A,43        ;GET FOURTH POINT
40F8 90        00072         SUB   B
40F9 47        00073         LD    B,A
40FA F1        00074         POP   AF
40FB CD0741    00075 PLOT4   CALL  PLOT        ;PLOT THE POINT
40FE E5        00076 COPY    PUSH  HL
40FF CDBB02    00077         CALL  699         ;KEY PRESS?
4102 24        00078         INC   H
4103 E1        00079         POP   HL
4104 28BA      00080         JR    Z,RESET     ;LOOP IF NOT
4106 C9        00081         RET               ;OTHERWISE RETURN
4107 C5        00082 PLOT    PUSH  BC          ;SUBROUTINE TO PLOT
4108 E5        00083         PUSH  HL
4109 323040    00084         LD    (16432),A   ;PLOT STATUS
410C CDB20B    00085         CALL  2994        ;PLOT/UNPLOT
410F E1        00086         POP   HL
4110 C1        00087         POP   BC
4111 C9        00088         RET
```

```
COPY    40FE 00076
DFILE   400C 00003   00006
DISP    40A5 00024   00029
DOPLOT  40E0 00057   00055
FIX     40B0 00030
FRAMES  4034 00004   00036
PAUSE   409D 00019
PLOOP   40A0 00020   00023
PLOT    4107 00082   00058 00064
                     00070 00075
PLOT1   40E1 00058
PLOT2   40EA 00064
PLOT3   40F3 00070
PLOT4   40FB 00075
PRINT   4082 00006
RESET   40C0 00037   00080
UNPLOT  40DE 00056   00053
VALS    40C4 00039   00045
WAIT    40B7 00033   00035
```



## TS2068 PORT ASSIGNMENTS

Timex provided SYNTAX with the following chart, referred to on page 214 of your 2068 manual. This chart is what you would receive if you contacted Timex Corporation for port assignments.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | | | | | | | | | 0 |
| 1 | | | | | | | | | | | | | | | | | 1 |
| 2 | | | | | | | | | | | | | | | | | 2 |
| 3 | | | | | | | | | | | | | | | | | 3 |
| 4 | | | | | | | | | | | | | | | | | 4 |
| 5 | | | | | | | | | | | | | | | | | 5 |
| 6 | | | | | | | | | | | | | | | | | 6 |
| 7 | | | | 9 | | | | 9 | | | | | | | | | 7 |
| 8 | 6 | 6 | 6 | 6 | | | | A | 6 | 6 | 6 | 6 | | | | | 8 |
| 9 | 6 | 6 | 6 | 6 | | | | | 6 | 6 | 6 | 6 | | | | | 9 |
| A | 6 | 6 | 6 | 6 | | | | | 6 | 6 | 6 | 6 | | | | | A |
| B | 6 | 6 | 6 | 6 | | | | | 6 | 6 | 6 | 6 | | | | | B |
| C | 6 | 6 | 6 | 6 | | | | | 6 | 6 | 6 | 6 | | | | | C |
| D | 6 | 6 | 6 | 6 | | | | | 6 | 6 | 6 | 6 | | | | | D |
| E | 6 | 6 | 6 | 6 | | | | | 6 | 6 | 6 | 6 | | | | 8 | E |
| F | 6 | 6 | 6 | 6 | 2 | 4 | 5 | 8 | 6 | 6 | 6 | 6 | 7 | 7 | 1 | 3 | F |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F | |

In the table, the vertical borders show the most significant hex digit and the horizontal borders show the hex digit of less significance. Table entries indicate devices from the numbered list that follows.

1. RD Keyboard/Cassette
   WR Border/Beep/Cassette
2. RD/WR Dock Horizontal Select
3. RD/WR Enhancement Port
4. WR Sound Chip Address
5. RD/WR Sound Chip Data
6. TS2040 Printer
7. Bank Switching
8. Micro-Drive
9. Modem
A. RD/WR Centronics Interface

Blanks in the table indicate ports available for use as of 2 Nov. 83.

Next month in SYNTAX we'll discuss the advanced video modes of the TS2068. You can find some information on this subject in the 2068 manual, appendix C.

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